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(71) Applicant (for all designated States except US): FRAEN  
CORPORATION S.R.L. [IT/IT]; Via Senato, 20, I-20121  
Milano (IT).

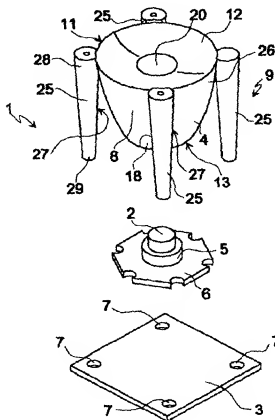
(72) Inventors; and

(75) Inventors/Applicants (for US only): ANGELINI,

Marco [IT/IT]; Via Milano, 20, I-27021 Bereguardo (IT).  
BIGLIATI, Claudia [IT/IT]; Via Montenero, 18, I-13039  
Trino (IT). BARALDO, Natile [IT/IT]; Via San Martino,  
22/A, I-20037 Paderno Dugnano (IT). SCODES, Luca  
[IT/IT]; Via Mazzini, 90, I-26866 Sant'Angelo Lodigiano  
(IT).(74) Agents: JORIO, Paolo et al.; Studio Torta S.r.l., Via  
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(54) Title: HIGH-HEAT-DISSIPATION LIGHTING MODULE



(57) Abstract: There is provided a lighting module (1) of the type having a solid state light source (2), in particular a LED, a supporting plate (3), and a lens (4); the lens (4) has a recess (14) housing the light source (2); the lens (4) is supported by and projects from the plate (3) by means of supporting members (25) carried by the lens (4) and for fitting the lens (4) directly to the plate (3); and the supporting members (25) are formed in one piece with the lens (4), and are spaced apart and separated from one another by cooling windows (27).

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

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## HIGH-HEAT-DISSIPATION LIGHTING MODULE

TECHNICAL FIELD

10       The present invention relates to a high-heat-dissipation lighting module of the type comprising a solid-state light source, in particular a LED, connected to a lens.

BACKGROUND ART

15       A lighting module of this type is known, for example, from Japanese Patent Application JP 61-147585, which describes a module comprising a LED supported on a mount, and a total-internal-reflection lens having a recess in which the LED is housed; and both the lens and  
20       the LED are housed in a cylindrical casing. By housing the LED/lens assembly inside a casing, this and other similar modules (a further example is described in US Patent 6274924) are difficult to produce, mainly on account of the necessity to assemble and connect the  
25       various component parts (the lens, in particular, is normally glued), and also have the major drawback of failing, in use, to effectively disperse the heat generated by the LED.

The problem of effectively cooling the LED is further compounded when the LED is housed inside a recess in the lens, in which case, dissipating plates fitted to the LED mount may not always be sufficient.

5       A further drawback lies in the lens normally being molded in a one-piece body from transparent polymer material. And since the lens is relatively thick, with an axial dimension comparable (i.e. substantially equal to or greater than) the transverse dimension, a relatively  
10 long molding time is required.

Moreover, the efficiency of total-internal-reflection lenses (and, therefore, of lighting modules equipped with them) is greatly affected by the condition of the reflecting surface, and may be impaired in the  
15 event the surface is damaged or even only contaminated. The problem therefore arises of effectively protecting the reflecting surface, both in use and, above all, when manufacturing and handling the lens and assembling the lighting module.

20       DISCLOSURE OF INVENTION

It is an object of the present invention to provide a lighting module of the type incorporating a solid-state light source (LED) and a lens, designed to provide a solution to the aforementioned problems of the known  
25 state of the art. More specifically, it is an object of the invention to provide a module with a high heat dissipation capacity, and which at the same time is cheap and easy to produce.

According to the present invention, there is provided a high-heat-dissipation lighting module of the type comprising a solid-state light source, a supporting plate, and a lens; the module being characterized in that  
5 said lens is supported by and projects from the plate by means of a supporting structure having cooling windows.

In a preferred embodiment, the lens comprises an optical body and a shell, for covering the optical body, which are made of respective different materials; the  
10 shell being positioned to cover a lateral surface of the optical body, and being separated from said lateral surface by a gap.

According to a further aspect of the invention, there are provided a lighting module and a lens that can  
15 be used in such a module, characterized in that the lens has an input surface facing the light source in use, and an output surface; which output surface has a dead cavity.

#### BRIEF DESCRIPTION OF THE DRAWINGS

20 A number of non-limiting embodiments of the invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a schematic, exploded view in perspective of a lighting module in accordance with the  
25 invention;

Figure 2 shows a schematic longitudinal section of the Figure 1 module assembled;

Figure 3 shows a partial exploded view of a

variation of the Figure 1 module;

Figure 4 shows a schematic section of a further variation of the Figure 1 module;

Figures 5 and 6 show, respectively, a schematic exploded view in perspective and a partial longitudinal section of a further embodiment of the invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Number 1 in Figures 1 and 2 indicates a lighting module comprising a solid-state light source 2, in particular a LED, a supporting plate 3, and a lens 4.

LED 2 is supported on a known mount 5 (shown only schematically) comprising an optional known dissipating plate 6. For the sake of simplicity, known contacts and connections for connecting LED 2 electrically to an external network are not shown. Mount 5 (or dissipating plate 6, if any) is fixed to plate 3 by known heat-conducting adhesive.

Plate 3 is a substantially flat heat-dissipating plate of any shape made, for example, of metal material, and has four seats 7 defined by respective circular-section through holes.

Lens 4 is a total-internal-reflection lens, and comprises a substantially cup-shaped optical body 8 made of transparent plastic material (e.g. polycarbonate PC or polymethyl methacrylate PMMA); and a supporting structure 9 by which lens 4 is supported by and projects from plate 3.

In the example shown, optical body 8 is a

rotationally symmetrical body of revolution, and has an axis of symmetry A. At a first axial end 11, optical body 8 comprises a flat or, as shown in the drawings, a saddle-shaped end surface 12; and, at a second axial end 13 opposite first axial end 11, optical body 8 comprises a recess 14 in which LED 2 is inserted.

Recess 14 is defined by a collar 15 radially and loosely surrounding LED 2 and terminating with an end edge 16, which fits onto mount 5 and rests axially on an annular shoulder 17 of mount 5.

In a preferred embodiment shown schematically by the dash line in Figure 1, collar 15 has radial through ventilation openings 18 terminating inside recess 14.

Optical body 8 also comprises a dead cavity 20 extending along axis of symmetry A from end surface 12 towards axial end 13, i.e. towards recess 14, and separated from recess 14 by a partition 21 bounded by two opposite faces 22, 23 respectively defining a flat bottom surface of cavity 20, and a curved bottom surface, facing LED 2, of recess 14.

Face 23, together with an inner lateral surface of collar 15, defines recess 14, and constitutes an input surface into optical body 8 for the light emitted by LED 2; face 22 and end surface 12 define an output surface for the light beam travelling through optical body 8; and a lateral surface, between axial ends 11 and 13, of optical body 8 defines an internal reflection surface of lens 4.

Cavity 20 may be of various shapes, e.g. substantially cylindrical or truncated-cone-shaped, extends along axis of symmetry A (which defines an optical axis of lens 4), and is substantially aligned with recess 14. Faces 22, 23 may be shaped otherwise than as shown herein by way of example : face 22, in particular, defines an auxiliary optical surface, which may be shaped to impart specific characteristics to the light beam emitted by lens 4. When designing lens 4, in addition to designing the overall shape and the input and output surfaces of optical body 8, the shape of the auxiliary optical surface may therefore also be designed to increase the number of types of beams obtainable.

Cavity 20 also reduces the thickness of optical body 8 as compared with that of a solid piece, thus greatly reducing molding time.

Supporting structure 9 comprises a number of supporting members 25 formed in one piece with optical body 8. In the example shown, four rod-shaped supporting members 25 are provided, and project from a peripheral edge 26 of lens 4 in a direction substantially parallel to axis of symmetry A. Supporting members 25 may be molded in one piece with optical body 8, e.g. from the same material as optical body 8, or may be co-molded or molded on, possibly from other materials than that of optical body 8.

Supporting members 25 are spaced, e.g. equally spaced, circumferentially along peripheral edge 26, which



also bounds end surface 12; and ample radial cooling windows 27 are defined between, and so separate, supporting members 25.

Supporting members 25 have respective longitudinal ends 28 for attachment to peripheral edge 26; and respective longitudinal ends 29 inserted and locked inside seats 7 in plate 3. More specifically, longitudinal ends 29 are inserted through seats 7 and riveted or clinched onto plate 3. In a variation not shown, longitudinal ends 29 click onto respective seats 7 in any known manner.

Lens 4 thus rests axially on mount 5 (by means of collar 15 cooperating with shoulder 17) and is secured to plate 3 by supporting members 25.

Supporting members 25 carried by, and in fact formed in one piece with, lens 4 therefore provide for fitting lens 4 directly to plate 3; and lens 4 is supported by and projects from plate 3 also by means of supporting members 25.

Figure 3, in which details similar to or identical with those already described are indicated using the same reference numbers, shows a variation of module 1 according to the invention, and which is identical to the one already described, except that supporting structure 9 is formed as a separate component from optical body 8, and is fitted to lens 4. More specifically, supporting structure 9 comprises a ring 30 from which supporting members 25 extend; ring 30 is housed in a seat 31 formed

along peripheral edge 26 of lens 4 and having an annular shoulder 32; and, when module 1 is assembled, longitudinal ends 29 of supporting members 25 are fitted to plate 3, and ring 30 rests axially on shoulder 32 to grip lens 4 onto mount 5 and therefore onto plate 3. Supporting members 25 and ring 30 may be made of the same or different material from optical body 8.

In the Figure 4 variation, in which details similar to or identical with those already described are indicated using the same reference numbers, lens 4 comprises a disk 33, from the peripheral edge 26 of which supporting members 25 extend; and a preferably hollow central portion 34 extending axially along axis of symmetry A from a face 35 of disk 33, and terminating with a partition 21 facing LED 2. Lens 4 is associated with a reflector 36 defined by a cup-shaped hollow body coaxially surrounding central portion 34 and having an inner surface 37 with a reflecting layer 38, e.g. chromium-plated, aluminized, etc.

Disk 33 and central portion 34 are formed in one piece with supporting members 25, e.g. from transparent polymer material, such as PC or PMMA, while reflector 36 is formed as a separate component, e.g. from opaque polymer material, such as ABS or similar.

At axially opposite ends, reflector 36 has an annular edge 39 resting on face 35 of disk 33, and a through hole 40 housing LED 2 and defined by a collar 15, which terminates with an end edge 16 for connection to

mount 5 and may have radially through ventilation openings (not shown).

Once longitudinal ends 29 of supporting members 25 are fitted to plate 3, reflector 36 is gripped between  
5 disk 33 and mount 5.

In the Figure 5 and 6 variation, in which details similar to or identical with those already described are indicated using the same reference numbers, supporting structure 9 comprises a cover shell 50 extending along  
10 axis A and coaxial with and radially outwards of optical body 8 to safeguard optical body 8 against contaminants and possible damage.

Optical body 8 is made of a first substantially transparent, low-absorbance polymer material, while shell  
15 50 (and, advantageously, the whole of supporting structure 9) is made of a second opaque polymer material of good mechanical strength.

Shell 50 is shaped to cover an outer lateral surface 51 of and defining a reflecting surface of optical body  
20 8; lateral surface 51 extends between axial ends 11 and 13 of optical body 8, and in particular between an input surface 52, defined by a surface bounding recess 14 and through which the light emitted by LED 2 enters optical body 8, and an output surface 53 defined by end surface  
25 12 and from which the light travelling through optical body 8 is emitted; and lateral surface 51 is shaped so that optical body 8 operates in total-internal-reflection mode.

Shell 50 has a curved wall 54 surrounding lateral surface 51 and defining internally a cavity 55 housing optical body 8.

5 : Shell 50 has two open, axially opposite ends 56, 57 : end 56 has a ring 60, from which supporting members 25 project axially (and are connected to curved wall 54 of shell 50 by respective ribs 62); and end 57 has a collar 63 aligned with and contiguous to recess 14 of optical body 8, and having radial openings 64.

10 Axial and circumferential retaining members are provided for securing optical body 8 axially and circumferentially inside cavity 55. For example, end 56 of shell 50 has projecting, radially inner teeth 65, which cooperate axially with end surface 12 of optical  
15 body 8 to secure optical body 8 axially inside cavity 55; and axial end 11 of optical body 8 has at least one radially projecting tooth 66 which engages a seat 67 formed in ring 60 to secure optical body 8 circumferentially inside cavity 55.

20 Shell 50 faces lateral surface 51 of optical body 8, and is separated from lateral surface 51 by a gap 71 for ensuring substantially all the light entering optical body 8 through input surface 52 is reflected by lateral surface 51 inside optical body 8. Optical body 8 thus  
25 operates in total-internal-reflection mode, with a high degree of efficiency, and with none of the dispersion phenomena which would occur if lateral surface 51 of optical body 8 were to contact shell 50 directly.

For this purpose, a very small gap 71 (even of micrometric proportions) is sufficient.

Shell 50 and optical body 8 may be formed as separate components and then fitted together (e.g. by fitting or clicking optical body 8 inside shell 50); in which case, gap 71 is defined by a small clearance between optical body 8 and shell 50.

Alternatively, gap 71 is formed when producing lens 4 : shell 50 and optical body 8 are made of respective appropriately selected polymer materials with no or very little chemical compatibility or affinity; and lens 4 is formed using a known two-material molding process (co-molding or overmolding). At a first step in the process, optical body 8 is molded from a first substantially transparent material; and at a second step in the process, shell 50 is molded from a second material having no or very little compatibility with the first material.

In the course of the two-material molding process, the mating surfaces between the two materials (i.e. between optical body 8 and shell 50) do not adhere to each other, owing to the poor compatibility of the materials; and, as the materials cool, gap 71 is formed by the difference in thermal shrinkage of the materials.

Examples of pairs of poorly compatible materials that can be used for shell 50 and optical body 8 are given in European Patent Application n. EP-A-0984249, the content of which is included herein by way of reference. For example, optical body 8 may be made of polycarbonate

or polymethyl methacrylate, and shell 50 of a polyolefin or polyamide polymer.

The whole of supporting structure 9 (including shell 50 and supporting members 25) may advantageously be made  
5 in one piece from the same material.

Besides centring and, more generally, ensuring correct positioning of optical body 8 with respect to LED 2, shell 50 also provides for effectively safeguarding optical body 8, and in particular lateral surface 51,  
10 against contaminants and possible damage, thus ensuring correct total-internal-reflection operation of optical body 8.

The advantages, as compared with the known state of the art, of module 1 according to the invention will be  
15 clear from the foregoing description.

In particular, module 1 can be produced and assembled easily, quickly, and relatively cheaply, for example, as follows : plate 3 (of the desired shape and size and complete with seats 7), the subassembly defined  
20 by LED 2 and mount 5 (possibly comprising dissipating plate 6), and lens 4 (e.g. molded integrally with supporting members 25) are produced separately; plate 3 is then fitted successively with mount 5 (e.g. bonded to plate 3 using conductive adhesive), and with lens 4, by  
25 inserting the longitudinal ends 29 of supporting members 25 through respective seats 7 and fitting collar 15 about LED 2; and, once lens 4 is aligned correctly with LED 2, longitudinal ends 29 are locked, e.g. hot-riveted, inside

respective seats 7. Fitting lens 4 directly to plate 3 eliminates the need for additional mechanical components and (unlike conventional systems) for relatively complex, time-consuming bonding operations, and can also be  
5 performed automatically or semi-automatically.

Moreover, in actual use, cooling windows 27 and optional ventilation openings 18 provide for effectively dissipating the heat generated by LED 2, which is also assisted by plate 3 and by fitting mount 5 to plate 3  
10 using conducting adhesive.

Clearly, changes may be made to the module as described and illustrated herein without, however, departing from the scope of the present invention.

## CLAIMS

1) A high-heat-dissipation lighting module (1) of the type comprising a solid-state light source (2), a supporting plate (3), and a lens (4); the module being  
5 characterized in that said lens (4) is supported by and projects from the plate (3) by means of a supporting structure (9) having cooling windows (27).

2) A module as claimed in Claim 1, characterized in  
10 that said supporting structure (9) comprises a number of supporting members (25) carried by the lens (4) and for fitting the lens (4) directly to the plate.

3) A module as claimed in Claim 2, characterized in that said supporting members (25) are spaced apart and  
15 separated from one another by said cooling windows (27).

4) A module as claimed in Claim 2 or 3, characterized in that said supporting members (25) project from a peripheral edge (26) of the lens (4) in a direction substantially parallel to an axis of symmetry  
20 (A) of the lens.

5) A module as claimed in one of Claims 2 to 4, characterized in that said supporting members (25) have respective longitudinal ends (29) inserted and locked inside respective seats (7) in the plate (3).

25 6) A module as claimed in Claim 5, characterized in that said longitudinal ends (29) are inserted through said seats (7) and riveted or clinched to the plate (3).

7) A module as claimed in one of Claims 2 to 6,



characterized by comprising a mount (5) on which said light source (2) is mounted; the lens (4) resting axially on said mount (5), and being secured to the plate (3) by the supporting members (25).

5        8) A module as claimed in Claim 7, characterized in that said mount (5) is fixed to the plate (3) by a heat-conducting adhesive.

9) A module as claimed in one of Claims 2 to 8, characterized in that said supporting members (25) are  
10      formed in one piece with the lens (4).

10       10) A module as claimed in one of Claims 2 to 8, characterized in that said supporting members (25) are formed as separate components from the lens (4), and are fitted to said lens.

15       11) A module as claimed in Claim 10, characterized in that said supporting structure (9) comprises a ring (30) from which the supporting members (25) extend; said ring (30) being housed in a seat (31) formed in the lens (4), and resting axially on an annular shoulder (32) of  
20      the seat (31) to grip the lens (4) to the plate (3).

12) A module as claimed in one of Claims 2 to 11, characterized in that said lens (4) comprises a disk (33), from a peripheral edge (26) of which the supporting members (25) extend, and is associated with a reflector  
25      (36) defined by a cup-shaped, hollow body coaxially surrounding said light source (2); said reflector (36) being gripped between said disk (33) and said plate (3).

13) A module as claimed in one of the foregoing

Claims, characterized in that said lens (4) comprises a recess (14) in which the light source (2) is inserted; the recess (14) being defined by a collar (15) radially surrounding the light source.

- 5        14) A module as claimed in Claim 13, characterized in that said collar (15) in turn comprises radially through ventilation openings (18).

- 15       15) A module as claimed in any one of the foregoing Claims, characterized in that said lens (4) comprises an optical body (8) and a shell (50), for covering the optical body (8), which are made of respective different materials; the shell (50) being positioned to cover a lateral surface (51) of the optical body (8), and being separated from said lateral surface (51) by a gap (71).

- 16       16) A module as claimed in Claim 15, characterized in that the lens (4) is a total-internal-reflection lens, and said lateral surface (51) defines a reflecting surface, shaped to operate in total-internal-reflection mode, of said optical body (8).

- 20       17) A module as claimed in Claim 15 or 16, characterized in that the optical body (8) and the shell (50) are made of respective polymer materials having no or very little compatibility, and which are co-molded or overmolded to form the optical body (8) and the shell  
25       (50) respectively.

- 18) A module as claimed in one of Claims 15 to 17, characterized by comprising axial and circumferential retaining members (65, 66, 67) for axially and

circumferentially securing the optical body (8) and the shell (50) to each other.

19) A module as claimed in any one of the foregoing Claims, characterized in that said lens (4) has an input surface (23) facing said light source (2), and an output surface (12); which output surface (12) has a dead cavity (20).

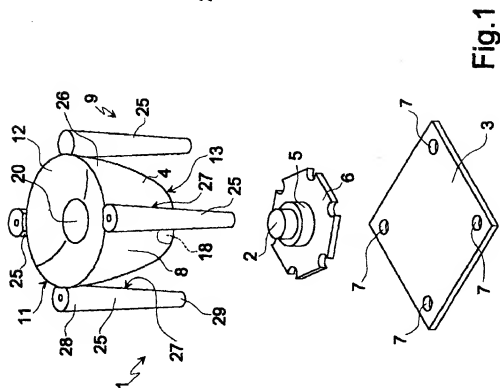
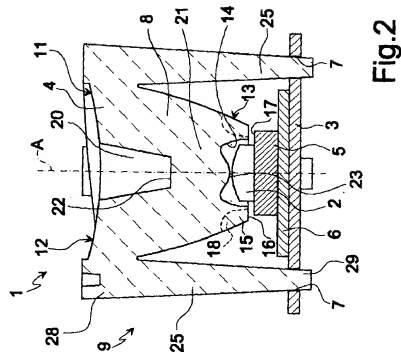
20) A lens (4), in particular a total-internal-reflection lens usable with a solid-state light source, having an input surface (23) and an output surface (12), and characterized in that said output surface (12) has a dead cavity (20).

21) A lens as claimed in the foregoing Claim, characterized by comprising a recess (14) for housing a light source (2); said cavity (20) being separated from said recess (14) by a partition (21).

22) A lens as claimed in the foregoing Claim, characterized in that said cavity (20) is located substantially along an optical axis (A) of the lens.

23) A lens as claimed in the foregoing Claim, characterized in that said cavity (20) is substantially aligned with said recess (14) along said optical axis (A).

24) A lens as claimed in the foregoing Claim, characterized in that said cavity (20) and said recess (14) are located at respective opposite axial ends (11, 13) of the lens.



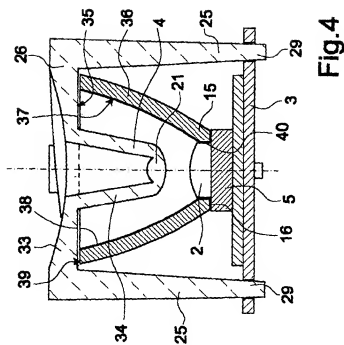
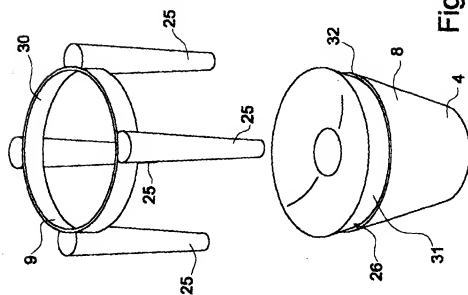


Fig. 4

Fig. 3

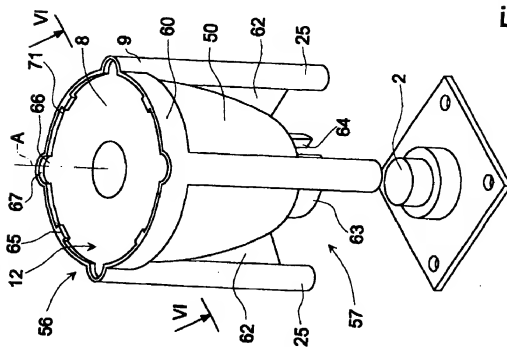


Fig.5

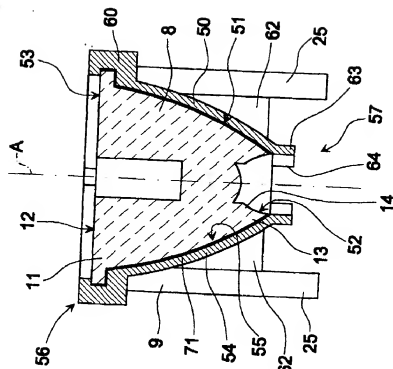


Fig.6

# INTERNATIONAL SEARCH REPORT

		Int. Patent Application No PCT/IT 02/00767
<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC 7 F21V29/00 F21V5/04 F21V3/04 B29D11/00 G02B17/00 H01L33/00		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) IPC 7 F21V B29D G02B F21S F21K H01L		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 00 36336 A (KONINKL PHILIPS ELECTRONICS NV) 22 June 2000 (2000-06-22)  page 8, line 3 - line 33 page 9, line 12 - line 23 page 9, line 30 - page 10, line 7 figures 3-6	1-8, 10-13, 19-24
Y	---	15-17
X	WO 99 09349 A (DECOMA INT INC ;BREAULT RESEARCH ORGANIZATION (US)) 25 February 1999 (1999-02-25) page 4, line 10 - line 16 page 8, line 5 - line 19 figures 1,4  --- ---	1-5,9, 19-24
-/-		
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "Z" document member of the same patent family		
Date of the actual completion of the international search 20 March 2003		Date of mailing of the international search report 27/03/2003
Name and mailing address of the ISA European Patent Office, P.B. 5618 Patentlaan 2 NL - 2280 HV Rijswijk Tel (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3316		Authorized officer De Mas, A

## INTERNATIONAL SEARCH REPORT

 Int. Patent Application No.  
 PCT/IT 02/00767

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WD 01 45180 A (ROHM CO LTD) 21 June 2001 (2001-06-21) abstract; figures 1-3	15-17
A		1
Y,P	& EP 1 174 930 A (ROHM CO LTD) 23 January 2002 (2002-01-23) column 3, line 24 - line 33 column 3, line 53 - column 4, line 1 column 4, line 16 - line 18 figures 1-3	15-17
A	---	1
A	US 5 173 810 A (YAMAKAWA MASAMI) 22 December 1992 (1992-12-22) column 2, line 66 - column 3, line 30 figures 1,4	1,15-18
A	---	
A	DE 197 28 354 A (SIDLER GMBH & CO) 7 January 1999 (1999-01-07) column 5, line 1 - line 10 figure 1	1,19-24
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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IT 02/00767

## Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-19

A high heat dissipation lighting module having as special technical feature a number of supporting members carried by the lens and opening in the lens collar for solving the problem of cooling of the module.

2. Claims: 20-24

Lens having as special technical feature an output surface including a dead cavity for solving the problem of excessive molding shrinkage.

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International Application No  
PCT/IT 02/00767

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